Appendix C6. Assessment of Potential Water Contaminants on the Delta Wetlands Project Islands

Appendix C6. Assessment of Potential Water Contaminants on the Delta Wetlands Project Islands

SUMMARY

This appendix presents the methods and conclusions of a 1993 analysis to determine whether harmful pesticide residues may be present in Delta Wetlands (DW) project island soils. The analysis was based on the results of a 1988 study of pesticide residues in DW project island soils, information on pesticide use subsequent to the 1988 investigation, and updated (1993) regulatory agency listings of chemicals of concern. It was determined that DW project island soils do not contain significant concentrations of agricultural chemicals and that past agricultural practices should not affect the quality of water stored on the DW project islands or used for wetlands and habitat management on the habitat islands.

This appendix also describes the potential water quality impacts of the addition of recreational boating facilities and the increase in boating activity in the Delta that may be associated with DW project implementation. The anticipated use of additional facilities and resulting increases in boating activity formed the basis for this evaluation. The data indicate that incremental additions of contaminants are not considered a significant source of water quality degradation, provided that compliance with applicable regulations and proper use of facilities by recreational users is maintained and legal enforcement actions are pursued.

AGRICULTURAL PESTICIDE RESIDUES

Introduction

Background

The DW project islands have been used intensively for agriculture for more than 50 years, and as a part of this use, a wide variety of insecticides, rodenticides, herbicides, and other synthetic organic chemicals have been applied to island soils. If residues of these chemicals were present in the soils, they could be leached into drainage or into the water stored on and discharged from the DW project islands. Concern over the water quality effects of possible pesticide leaching led to the 1988 study of island soils.

To determine whether residues of agricultural chemicals of concern were present in DW project island soils, Jones & Stokes Associates (JSA):

- conducted a survey in November 1988 to identify the agricultural chemicals that had been used on the four project islands,
- screened these against regulatory agency lists of agricultural pesticides suspected of leaching to groundwater or of otherwise posing risks to human health or the environment,
- developed a list of target chemicals for which island soil samples would be tested, and
- conducted limited sampling and analysis of the soils to determine whether residues of these target pesticides were present.

The results of the investigation were presented in the 1990 draft EIR/EIS on the DW project.

Study Objective

The objective of the study described in the following sections was to determine whether there currently exist agricultural chemical residues in DW project island soils that could leach into stored water on the islands in concentrations that would violate current state or federal water quality standards for the protection of human health or wildlife.

The study involved examining the results of the 1988 soil investigation and assessing their implications with regard to 1993 soil conditions, and updating the analysis based on recent agricultural practices and current U.S. Environmental Protection Agency (EPA) and California Department of Food and Agriculture (CDFA) lists of agricultural chemicals suspected of leaching or known to leach to groundwater. As described below, it was determined that additional soil sampling and analysis were not necessary in 1993.

Screening for Target Pesticides

To identify the target pesticides for which soil samples should be tested, JSA compiled a list of agricultural chemicals used on the DW project islands and screened them against regulatory agency lists of chemicals of concern. Information from CDFA and EPA was used to determine which of the pesticides used on the DW project islands have the potential to leach to groundwater; subsurface soil samples would be tested for residues of these target pesticides. The list of agricultural chemicals used on the islands was also screened against a list of carcinogens and other toxic chemicals not considered by CDFA or EPA to have the potential to leach to groundwater, compiled using information from California Department of Health Services (DHS), California Department of Water Resources (DWR), and California State Water Resources Control Board (SWRCB) with California Department of Fish and Game (DFG); surface soil samples would be analyzed for residues of those chemicals used on island soils that also appeared on this list.

This section describes 1988 and 1993 agricultural chemical use patterns, the criteria used to screen for potential chemicals of concern among those pesticides used on the DW project islands, and the resulting list of pesticides that were the focus of this investigation in 1988 and 1993.

Several heavy metals (arsenic, cadmium, copper, lead, and mercury) were included in the target list for surface and subsurface residuals because of the possibility of heavy metal contamination resulting from disposal of waste paper pulp on Holland Tract and the existence of a copper wire recovery site on Bacon Island.

Pesticides Used on the DW Project Islands

JSA compiled a list of all agricultural chemicals used on the project islands based on information obtained in interviews with local farmers and representatives of the San Joaquin County agricultural commissioner's office and the local reclamation district.

Use Patterns in 1988. Sixty agricultural chemical compounds were identified in 1988 as having been used on the project islands, and many were commonly used on all four islands (Table C6-1). In general, Bacon Island has had the highest agricultural chemical use of the islands.

Update of Use Patterns. Since the 1988 inventory was conducted, cropping patterns and associated pesticide use on Bacon and Bouldin Islands have changed, while pesticide use on Holland and Webb Tracts have remained nearly the same. This section provides brief updates of chemical use patterns for each island.

Bacon Island. The San Joaquin County agricultural commissioner's office and farmers on Bacon Island indicate that, in general, the number of pesticides and amounts applied on Bacon Island have been reduced significantly as a result of changes in cropping patterns and pesticide costs (Shimasaki and Hudson pers. comms.).

Kyser Farms, one of the island's largest tenant farming operations, has reduced the acreage committed to asparagus, potatoes, and grapes because of nematode infestations and reductions in yields (Shimasaki pers. comm.). Agricultural use of certain pesticides, such as Bayleton, Benlate, and Kryocide, have been reduced substantially because of Kyser Farms' changes in cropping patterns and the reduction in grape production; this has resulted in a significant reduction in the total chemical use on the island. Additionally, concerns over potential liabilities associated with use of restricted agricultural chemicals have contributed to overall reductions in pesticide use.

Bouldin Island. Cropping patterns on Bouldin Island have changed since 1988 and chemical use has been reduced significantly. Recently, corn and wheat have been the primary crops grown on the island. Devrinol, a preemergent herbicide for general weed control;

atrazine; and 2,4-D are used on wheat. Garlon (triclopyr) is used for blackberry control. Atrazine, Garlon, and 2,4-D are restricted chemicals and are applied by a CDFA-registered pesticide applications specialist. (Wilkerson pers. comm.)

The airstrip on Bouldin Island is currently used by aircraft for agricultural spraying. No fueling or chemical storage and mixing facilities are located at the airstrip. Licensed applicators bring the mixed pesticides and herbicides to the airstrip where it is loaded onto the aircraft. Unused pesticides/herbicides are not stored or disposed on the island.

Holland Tract. Corn and wheat are the primary crops grown on Holland Tract. Pesticide use patterns on Holland Tract have remained about the same as those of previous years, and no new CDFA-restricted chemicals have been used on the island (Cockrell pers. comm.).

Webb Tract. Pesticide use on Webb Tract has remained nearly the same since 1988 because cropping patterns on the island have not changed substantially (Wilkerson pers. comm.). No new CDFA-restricted chemicals have been used on the island (Hudson pers. comm.). Corn and wheat are the main crops grown on the island.

Determination of Pesticides with Leaching Potential

Information Sources and Criteria for Selection. Two sources of information, CDFA and EPA, were consulted for lists of agricultural chemicals suspected of having high potential to leach to groundwater. CDFA, in response to requirements of the Pesticide Contamination Prevention Act (PCPA) of 1986 (Assembly Bill [AB] 2021), conducts a monitoring program for municipal water supplies and a pesticide review process to identify agricultural compounds that may leach to groundwater. The PCPA was enacted as a result of the detection of harmful concentrations of agricultural chemicals in wells for municipal drinking water supplies throughout the state. The PCPA requires CDFA, in cooperation with DHS and SWRCB, to maintain a statewide database of wells sampled for active pesticide ingredients and report findings annually to the California Legislature.

In addition to monitoring municipal water supplies, CDFA evaluates pesticides for potential to contaminate groundwater. As required by the PCPA, CDFA developed a screening method to determine whether an organic chemical has a high potential to leach to groundwater; the method is based on comparison with specific numerical values (SNVs) established for five chemical characteristics: octanol-water partition coefficient, hydrolysis, water solubility, aerobic metabolism, and anaerobic metabolism The SNVs are values that CDFA believes are indicative of an organic chemical's ability to leach to groundwater. The SNVs for these characteristics are:

- octanol-water partition coefficient: 2,400 grams per cubic centimeter (gm/cm^3),
- water solubility: greater than 3 parts per million (ppm),
- hydrolysis: greater than 14 days half-life,
- aerobic metabolism: greater than 730 days half-life, and
- anaerobic metabolism: greater than 9 days half-life.

The SNVs are subject to revision as additional research and data become available. For example, the octanol-water partition coefficient was 512 gm/cm^3 in 1987 and has been increased to 2,400 gm/cm^3 based on new information and research. In contrast, the water solubility value was decreased in 1987 from 7 ppm to 3 ppm. These slightly modified SNVs better represent leaching potential, and it is unlikely that the SNVs will change significantly in the future. (Johnson pers. comm.) The SNVs for active ingredients of various chemicals are developed from information obtained from the chemical manufacturers.

The PCPA requires that CDFA obtain data on these chemical characteristics and environmental fate information from the manufacturer of a compound or from available literature before a compound can be evaluated. Pesticide manufacturers have begun to submit the required information and many chemicals have been evaluated since enactment of the PCPA.

Annual reports to the California Legislature prepared by CDFA, DHS, and SWRCB list agricultural chemicals detected in groundwater and chemicals with the potential to leach to groundwater (based on exceedance of SNVs) (CDFA 1987, 1992). CDFA's 1992 report lists six agricultural compounds detected in groundwater and 49 compounds that meet or exceed the SNVs and are therefore considered to have the potential to leach to groundwater (Table C6-2).

Additionally, EPA has been conducting a nationwide pesticide survey of community and domestic drinking water systems and has prepared a list of about 70 compounds considered to have the greatest potential for leaching to groundwater.

Pesticides Identified as Having Leaching Potential in 1988. The list of agricultural chemicals used on the DW project islands was compared with the combined CDFA and EPA lists of chemicals so that the target compounds for subsurface soil analysis could be determined. The following chemicals were selected for the 1988 subsurface soil analysis (Table C6-3): Aldrin, aminotriazole, atrazine, dicamba, dinoseb, glyphosate, diuron, methomyl, linuron, MCPA, Monitor, carbaryl, aldicarb, 2,4-D, 2,4,5-T, dieldrin, DDT and metabolites, and methyl bromide. Glyphosate and aminotriazole were dropped from the target list, with concurrence from SWRCB, because of inherent problems in performing analyses for these compounds (Falkenstein pers. comm.).

Additional Pesticides Identified as Having Leaching Potential in 1993. Two pesticides, disulfoton and parathion, have been added to the CDFA list of chemicals since the 1988 investigation.

Disulfoton. Disulfoton is a systemic organophosphorus insecticide-acaricide sprayed to control many insects, including mites (Farm Chemicals Handbook 1989); its stated effectiveness is 6-8 weeks. Disulfoton is moderately toxic to trout and bluegill at 3.0 ppm and 0.039 ppm, respectively. This pesticide has not been detected by CDFA in the PCPA groundwater monitoring program (CDFA 1992). Disulfoton is listed by CDFA as having the potential to leach to groundwater because its hydrolysis half-life (176 days) exceeds the CDFA criterion of 14 days. (The hydrolysis half-life is an estimate of the time it takes for 50% of a compound to break down through hydrolysis.)

The EPA Office of Drinking Water, as part of its Health Advisory Program, prepared a detailed analysis of disulfoton in 1988 (EPA 1988a). The Health Advisory Program evaluates the chemical properties, occurrences, environmental fates, and health effects of synthetic organic compounds and develops 1-day, 10-day, and lifetime health advisories for each chemical reviewed. The health advisory specifies a chemical concentration at which adverse health effects would not be anticipated to occur over specific exposure durations; it serves as an informal technical guidance for local health officials for protecting public health when chemical spills occur.

The following are some of the highlights of EPA's analysis of the environmental fate of disulfoton:

- disulfoton was found in only one of 368 surface water samples and none of 1,182 groundwater samples analyzed;
- mobility of disulfoton in soil appears to decrease as organic matter content and cation exchange capacity increase;
- in field plots of sandy loam soil, granular disulfoton exhibits a half-life of 1 week and 90% loss after 5 weeks; and
- disulfoton is likely to be found in runoff water and sediment from treated and cultivated fields.

The EPA lifetime health advisory for disulfoton is 0.3 parts per billion (ppb).

Disulfoton has been used intermittently on all four project islands. On Bacon Island, it was used on 20 acres once in 1993 on an experimental basis so its effectiveness in controlling soil-borne insects could be evaluated. It was not used between 1988 and 1992 and future use is not anticipated (Shimasaki pers. comm.). Disulfoton has not been used on Bouldin Island in the last 5 years. Intermittent applications of disulfoton have been used on Holland and Webb Tracts.

New soil testing for disulfoton was determined to be unwarranted based on the following information:

- disulfoton was applied in small amounts and its use on the islands where it was applied was highly focused,
- disulfoton is a restricted chemical and was applied according to the manufacturers' instructions by CDFA-registered pesticide application specialists,
- the high organic matter content of island soils provides for adsorption of disulfoton and prevents its migration, and
- environmental fate data suggest that disulfoton concentrations dissipate within a growing season.

Based on this information, it is unlikely that water stored on the DW project islands would have disulfoton concentrations that exceed the EPA health advisory. Additionally, disulfoton has never been detected in the Delta by DWR in the Interagency Delta Health Aspects Monitoring Program during 41 separate sampling events since 1983 (DWR 1989).

Also, the DW project islands have extensive deposits of organic peat, and research conducted by CDFA and others has shown that, in general, soils with higher organic carbon content tend to have lower contaminant concentrations. This may be attributable to the effective filtration of carbonaceous soils and the prolific soil bacteria populations that organic soils support. Additionally, CDFA research suggests that soils high in organic carbon tend to bond more with pesticides, a phenomenon that could result in increased rates of degradation and reduced rates of leaching (CDFA 1989).

Parathion. Parathion is an organophosphorus insecticide used to control a wide variety of insects. The compound is generally considered to be insoluble in water. Parathion was listed by CDFA as having the potential to leach to groundwater because of its estimated hydrolysis half-life of 302 days, which exceeds the CDFA SNV of 14 days.

Parathion has not been used on Bacon Island since 1989. It has been used occasionally on the other DW project islands.

Parathion residues have been detected in six of 45 sampling events conducted by DWR in the Interagency Delta Health Aspects Monitoring Program. The highest concentration reported was 0.035 ppb. A comparison with the state drinking water criterion for parathion (30 ppb) indicates that concentrations are not at levels of concern.

Based on this information, JSA determined that additional testing of DW project island soils for parathion residues is not warranted.

Other Pesticides Posing Environmental or Health Risks

Information Sources. The list of pesticides used on the DW project islands was compared with a list compiled from information from DHS, a DWR program, and a program of SWRCB and DFG (described below) to determine whether any of the chemicals used on the islands had been detected in Delta water quality monitoring programs or were listed by the state as chemicals of concern. The list compiled from these three sources was developed primarily to identify chemicals that could pose a threat to human health or the environment but that are not necessarily found on the CDFA and EPA list of chemicals with the potential to leach to groundwater. Chemicals used on the DW project islands that appeared on the list compiled using the DHS, DWR, and SWRCB and DFG information were the subjects of surface soil analysis in the 1988 study. There were no additions to these listings warranting additional soil testing in 1993.

The following are the sources used and brief descriptions of the information obtained from each:

- DHS Safe Drinking Water and Toxic Enforcement Act (Proposition 65) list of chemicals known to the state to be carcinogenic or cause reproductive toxicity. This list was reviewed to identify those compounds used on the islands that may be considered toxic. (California Health and Welfare Agency 1988, 1993.)

- DWR Delta Water Quality Monitoring Program for Water Right Decision 1485. DWR has developed a pesticide rating and screening system to enhance its monitoring efforts in the Delta (DWR 1986). The active ingredients, environmental fate, and chemical behavior of compounds are used to rate potential impacts on drinking water quality. Water is sampled and tested for pesticides each year in May and September. Annual reports were reviewed for this study.

- SWRCB and DFG Toxic Substances Monitoring Program (TSMP). The TSMP evaluates trends in synthetic organic compounds and heavy metals by sampling fish and other aquatic organisms in the major rivers of California. The TSMP is a water quality assessment approach based on an organism's ability to "integrate" toxicant exposure over time and concentrate chemicals to measurable levels. Tissue samples are analyzed for several heavy metals and synthetic organic chemicals. Annual reports from 1976 through 1990 were reviewed to determine which compounds used on project islands may have been detected previously in Delta fish and aquatic organisms.

Pesticides Meeting Selection Criteria for Soil Residue Analysis in 1988. Based on a review of the information described above, the following pesticides were selected for surface soil analysis: aldicarb, atrazine, dicamba, dinoseb, dicofol (trade name Kelthane), methomyl, methamidophos, paraquat, toxaphene, 2,4-D, and DDT and its metabolites (Table C6-4). Dicofol was dropped from the target list of chemicals for analysis because of difficulties involved in laboratory analysis (Cornacchia pers. comm.).

Soil Sample Collection and Analysis

This section describes collection and analysis procedures for both surface and subsurface soil samples on the project islands.

Sample Collection Procedures

Surface Soils. Surface soils from actively farmed or fallow areas on each island were arbitrarily selected for sampling. Samples were collected with a stainless steel trowel from a maximum depth of 6 inches and transferred to a mixing bowl, where they were mixed thoroughly to produce one composite sample from each island. Sample weights were recorded by the testing laboratory. The sampling trowel was rinsed with an organic solvent (hexane) and deionized water and allowed to dry before being used for collecting samples at other locations.

Subsurface Soils. Soil core samples were collected from two arbitrarily selected locations in proposed sand borrow areas on each island using a hollow-stemmed auger drill with a split spoon sampler. The number of samples taken from each site depended on its stratigraphic conditions. If the soils were uniform in a bore hole, one soil sample was collected at the maximum typical depth of the proposed sand dredging (20 feet). Where distinct subsurface strata were present, samples were collected from each stratum to document differences in pesticide and trace metal concentrations between strata.

Samples were retrieved from the sampler, labeled, and stored in a cooler (subsurface samples were not composited). Augers from the drilling operation were steam cleaned before they were used at another location.

Sample Locations

Figure C6-1 shows the locations of surface and subsurface soil sampling conducted on the DW project islands. Sampling was conducted in October and November 1988.

Bacon Island. Surface soil was collected from three locations on Bacon Island, and subsurface soil samples were collected from three formations in two borings. In boring E-5, the soil consisted of a uniform brown to dark brown, well-sorted, medium-grained, loose to medium-dense sand. Groundwater was encountered near the 6-foot depth. A single sand sample was collected for analysis at depth of 16.0-16.5 feet because of the uniform sand conditions down to that point. In boring E-6, a thin surface veneer of moist, brown organic peat was encountered, underlain by a very moist, gray organic silt that graded to a gray silty sand. Because two distinct strata were present, two subsurface samples were collected from this boring at depths of 1.5-2.0 feet and 16.0-16.5 feet.

Bouldin Island. On Bouldin Island, surface soils were sampled at two locations and subsurface soils were collected from two locations. Borehole E-7 was on the western end of the island in a harvested sunflower field, approximately 500 feet north of the Camp 5 pump station. Borehole E-8 was 100 feet south of SR 12, halfway across the island. Each boring was drilled to 20 feet.

Two major subsurface soil groups were observed on Bouldin Island. In both boreholes, dark brown, slightly moist deposits of organic peat were found to a depth of about 15 feet and were immediately underlain by very moist, plastic gray silt. Samples of peat and silt from various depths were analyzed.

Holland Tract. Three surface soil samples were taken from Holland Tract. Soil borings were located in actively farmed fields. A uniform gray silty sand formation was encountered in both boreholes. A layer of peat approximately 1-2 feet thick was encountered in boring E-2 also; peat was not encountered in boring E-1. The estimated groundwater depth was 10 feet. Samples were taken from depths of 2.5-3.0 feet and 11.0-11.5 feet.

Webb Tract. Three surface soil samples were collected on Webb Tract from a cornfield, a sunflower field, and a fallow field. Two borings were performed. Soil and subsurface conditions were consistent between boreholes. The upper horizon consisted mainly of a brown silty sand interlaced with thin stringers of peat; groundwater was observed at a depth of 7 feet; and a moist, gray silty sand was encountered at 15 feet. Total depth of both boreholes was 16.5 feet. Samples from the upper and lower horizons were submitted for analysis. The sample collected from the lower horizon was saturated with groundwater.

Sample Analysis Procedures and Results

Soil sample testing was completed in December 1988. The following EPA-approved laboratory methods were used for organic chemical analyses:

- organochlorine pesticides and PCBs - EPA Method 8080,
- triazine herbicides - EPA Method 8190,
- carbamate and urea pesticides - EPA Method 632, and
- chlorinated phenoxy acid herbicides - EPA Method 8150.

Heavy metals (arsenic, cadmium, copper, lead, and mercury) were analyzed using the DHS California Assessment Manual Waste Extraction Test. Results of the soil sample analysis are shown in Tables C6-3 and C6-4.

Bacon Island. No detectable residues of pesticides were found in the soil borings collected on Bacon Island. Copper was found at the detection limit of 0.10 ppm in the upper soil horizon sample of soil boring E-6.

No organochlorine pesticides, chlorinated phenoxy herbicides, or triazine herbicides were detected in Bacon Island surface soils. Two urea-based herbicides, diuron and linuron, were detected at levels of 1,400 ppb and 1,100 ppb, respectively. No metals were found to be above their respective detection limits.

Bouldin Island. No pesticide residues or soluble metals were detected in Bouldin Island subsurface core samples.

Traces of the organochlorine pesticides DDT and dieldrin and of the triazine herbicide atrazine were found in Bouldin Island soils. Copper was the only trace metal detected in Bouldin Island surface soils.

Holland Tract. No pesticides or metals were detected in the Holland Tract subsurface soil samples.

Dieldrin and atrazine were detected in Holland Tract surface soils at concentrations of 25 ppb and 49 ppb, respectively. The subsurface soil analysis data indicate that these pesticides have not migrated deeper into the soil. No trace metals were detected (detection limits and methods used are shown in Table C6-4).

Webb Tract. No pesticides were detected in Webb Tract subsurface soils. Copper was found at the detection limit in soil boring E-4 at the 3.5- to 4.0-foot depth.

No organochlorine, chlorinated phenoxyacid, or triazine pesticides were detected in Webb Tract surface soils. Analysis was also conducted for trace metals such as arsenic and copper, the functional components of some of the earliest pesticides, but no concentrations of these metals were found (see Table C6-4 for detection limits).

Assessment of Water Contamination Potential

This section provides an interpretation of the results of the soil sample analysis and an assessment of the water contamination potential for each island.

Potential Contamination of Water on the Reservoir and Habitat Islands

Bacon Island. Small amounts of the urea-based pesticides diuron and linuron were detected in the Bacon Island soils. Both pesticides are used on asparagus fields; diuron is typically applied in February for preemergent weed control, and linuron is applied in April and September for postemergent weed control. In general, the half-lives of urea pesticides are relatively short compared with those of other families of pesticides (SWRCB 1983).

Diuron. CDFA conducted a review of diuron in 1987 in response to provisions of the PCPA. Detection of diuron in approximately one-third of groundwater wells in Tulare County provided the impetus for reviewing the compound's toxicology, use, and potential relationship to groundwater pollution.

EPA and SWRCB have not established specific numerical water quality goals or criteria for diuron (Central Valley Regional Water Quality Control Board [CVRWQCB] 1993). The CDFA Pesticide Registration and Evaluation Committee (PREC) found that lack of health data prevented establishment of a pollution standard. The PREC did, however, recommend modification of use in certain areas of the state (Ali pers. comm.).

Diruon, detected in Bacon Island surface soils at 1,400 ppb, is not expected to cause substantial surface water quality impairment on Bacon Island because diuron was applied on only a small acreage, concentrations observed in 1988 should have diminished substantially as a result of hydrolysis and other natural degradation processes, the pesticide had not been applied again by the time of this 1993 analysis, and peat soils observed on the island provide substantial absorption and activation sites for microbial degradation. Whatever residual concentrations might still remain in island soils when the island is flooded under DW project operations would be substantially diluted with the large volume of water stored on the island.

Linuron. Linuron was detected in surface soils from Bacon Island at 1,100 ppb. The asparagus field sampled as part of this study was sprayed with linuron approximately 3 weeks prior to sampling; positive detection of linuron was therefore anticipated. Asparagus was grown on this particular field for 6 consecutive years. (Shimasaki pers. comm.) Linuron is classified by CDFA as a chemical with leaching potential (CDFA 1992). EPA has set a drinking water health advisory for linuron of 1.4 micrograms per liter (μg/l).

Linuron is not expected to cause substantial surface water quality impairment on Bacon Island for the reasons given above for diuron.

Copper. The low concentration of copper detected in soil boring E-6 is considered to represent a background or ambient level. Copper levels in soil must exceed 250 ppm (250,000 ppb), or 250 milligrams per liter (mg/l), to be considered hazardous by DHS.

Bouldin Island

DDT. Concentrations of DDT were detected at 150 ppb in Bouldin Island surface soils; this is not uncommon for agricultural soils in the Delta. DDT is a persistent chlorinated pesticide that has extremely slow degradation rates. DDT was commonly used as a general pesticide until it was banned in the United States in 1971. DDT is classified as a human carcinogen by DHS.

A product frequently used to replace DDT is dicofol, another chlorinated hydrocarbon pesticide. DDT and dicofol are manufactured using a similar process, and minor impurities of technical-grade DDT have been found in dicofol formulations such as Kelthane (Cornacchia pers. comm.). DDD and DDE, the metabolic breakdown products of DDT, were not detected on Bouldin Island, suggesting that the DDT levels observed were probably the result of past applications of Kelthane or were residuals from past applications of DDT.

There are numerous regulatory criteria for DDT found in soils, water, and food items. Concentrations of DDT in soil or other materials exceeding 1.0 ppm (or 1,000 ppb) are considered hazardous waste by DHS, as codified in the California Health and Safety Code. Soluble concentrations of DDT in water or other fluids exceeding 0.1 mg/l (100 ppb) are also considered hazardous. A more stringent standard of 1 μg/l has been established as cause for concern under the California Safe Drinking Water and Toxic Enforcement Act (Proposition 65).

DDT levels detected in Bouldin Island soil samples do not exceed the DHS hazardous waste criterion. It is unlikely that DDT levels in the soil would cause water discharged from the island to exceed either the DHS or Proposition 65 levels because DDT is a chlorinated hydrocarbon that has very low water solubility and a strong affinity for organic matter. Additionally, DDT has never been detected in water samples collected by the DWR Delta monitoring program despite testing for DDT having been performed more than 47 times since 1983, when the program was initiated. Very low concentrations of 4,4'-DDD (0.004 μg/l) and 4,4'-DDE (0.007 μg/l), metabolic breakdown products of DDT, were occasionally detected at Vernalis and Rock Slough but not at concentrations of concern (DWR 1988, 1989). The DWR pesticide monitoring results indicate, in general, that DDT and other pesticides do not constitute a significant threat to drinking water obtained from the Delta (DWR 1989).

Dieldrin. Dieldrin was detected in Bouldin Island surface soils at a concentration of 200 ppb. Dieldrin, like DDT, is a persistent organochlorine insecticide that has shown bioaccumulative and bioconcentration properties. Dieldrin is now banned in the United States, and the levels observed are probably residues from past applications. The low levels detected are typical for agricultural lands in the Delta. Dieldrin is not listed by DHS as being detected in groundwater or having the potential to leach to groundwater; it is listed by EPA as suspected of having potential to leach to groundwater.

Dieldrin concentrations greater than 8 ppm (8,000 ppb) in soil are considered hazardous by DHS, as codified in the California Health and Safety Code. The dieldrin levels detected in Bouldin Island soil do not exceed this DHS criterion and therefore are not considered hazardous to human health.

Several water quality criteria and goals for dieldrin have been established by various agencies. The most relevant to the DW project islands are the California Proposition 65 regulatory level (0.02 ppb), the Inland Surface Waters Plan criterion (0.00014 ppb as a 30-day average), and EPA acute and chronic criteria (2.5 ppb and 0.0019 ppb, respectively) for protection of aquatic life.

It is unlikely that the observed dieldrin concentrations in Bouldin Island soil would result in water used on the island under DW project operations having concentrations that exceed established water quality criteria because of the low water solubility of dieldrin, the high volume of circulated water compared with the soil concentrations, and the likelihood that dieldrin concentrations observed in 1988 have been reduced through natural degradation processes.

Dieldrin has been detected in only three out of 47 sampling events in the DWR surface water monitoring program. The highest concentration observed was 0.005 $\mu g/l$ (0.005 ppb) (DWR 1989). Dieldrin was detected at the San Joaquin River at Vernalis, Delta-Mendota Canal (DMC), and Clifton Court Forebay. In general, the DWR data generally indicate that the maximum concentration observed for Dieldrin does not violate drinking water standards but may exceed EPA's chronic criterion for protection of freshwater aquatic life.

Atrazine. Over the past 35 years, atrazine has been the most heavily used herbicide in the United States. Atrazine is used for nonselective weed control with corn, sorghum, sugar cane, pineapple, and other plants (EPA 1988b) and is listed by CDFA as an agricultural chemical detected in groundwater (CDFA 1992). Atrazine is used widely in the Delta. On Bouldin Island, it is used as an herbicide in cornfields.

Atrazine has been studied by EPA's Office of Drinking Water in its Health Advisory Program. Some of the highlights of EPA's study include the following:

- Atrazine is commonly found in surface water and groundwater in EPA monitoring programs.
- Atrazine is moderately to highly mobile in soils ranging in texture from clay to gravelly sand.
- Soil adsorption coefficients for atrazine are highest for peat soils and lowest for sandy loams.

The reported concentration of atrazine in Bouldin Island soils was 320 ppb. The detection of the herbicide in Bouldin Island soils was expected because it had been applied to cornfields during the 1988 growing season.

There are no established standards for atrazine in soil (Duncan pers. comm.). However, EPA has established an advisory concentration of 25 ppb for atrazine in drinking water (CVRWQCB 1993).

It is unlikely that atrazine concentrations in Bouldin Island soils would result in the water used on the island under DW project operations having concentrations that exceed the EPA health advisory because of dilution by habitat management water and the low atrazine levels in the soil and because concentrations are reduced over time by natural degradation processes. Additionally, atrazine has only been detected once in 17 DWR sampling events; the highest concentration observed was 0.18 $\mu g/l$ (0.018 ppb) in an agricultural drain at Empire Tract (DWR 1989). These data appear to indicate that although atrazine use in the Delta is relatively high compared with use of other chemicals, atrazine is not found in surface waters at concentrations of concern (DWR 1988, 1989).

Copper. At 0.2 ppm, the concentration of copper detected in Bouldin Island surface soils was slightly above the detection limit of 0.11 ppm. Copper is naturally present in soils and is considered a micronutrient for plants. The observed level is considered a background concentration and does not exceed the DHS hazardous waste criterion of 250 ppm.

Holland Tract

Dieldrin. Small concentrations of dieldrin (25 ppb) were detected in Holland Tract surface soils; these were well below the DHS hazardous waste criterion of 8,000 ppb. As discussed previously, the low concentrations of dieldrin should not result in waters on Holland Tract having concentrations that exceed established state or federal criteria.

Atrazine. Detection of atrazine in Holland Tract soils (49 ppb), as in the Bouldin Island soils, reflected its recent use prior to soil sampling. A substantial amount of corn was grown on Holland Tract in 1988. The low level of atrazine observed should not result in waters on Holland Tract having concentrations that exceed established state or federal criteria.

Webb Tract. None of the target pesticides were detected in surface or subsurface soils collected from Webb Tract. The level of copper detected is considered a background concentration.

Potential Contamination of Habitat Management Water

Bouldin Island and Holland Tract would be managed as wetlands and wildlife habitat with implementation of Alternative 1 or 2, and a portion of Bouldin Island would be used to provide limited compensation habitat under Alternative 3. Smaller volumes of water would be diverted onto these islands for wildlife habitat maintenance than onto the reservoir islands. Wetlands and aquatic vegetation will be maintained for waterfowl and other wetland-dependent wildlife species. The potential contamination of habitat management water with pesticide residues in island soils is an issue of concern.

Pesticide residues in Bouldin Island and Holland Tract soils would not pose a water quality problem or cause toxicity to waterfowl for the following reasons:

- Delta water quality monitoring by DWR has shown, in general, that pesticides are rarely detected as part of routine testing. These data indicate that pesticide pollutant load in Delta waters is low and that pesticides are either degrading to nondetectable levels or adsorbing to silts and clays and accumulating in river sediments.

- Rice fields in the upper Sacramento Valley and other areas of intensive agricultural operations are commonly flooded for use as waterfowl feeding and roosting areas. Such practices have not caused any significant waterfowl problems, according to DFG (Wernette pers. comm.).

- Waterfowl management operations at state and federal wildlife management areas and refuges that have used agricultural lands have also used pesticides and agricultural chemicals, apparently with no major water contamination problems or instances of waterfowl mortality caused by pesticide residues (Wernette pers. comm.).

- Pesticide use on Bouldin Island and Holland Tract will be reduced substantially with implementation of the DW project, reducing pesticide use in the central Delta.

- Peat deposits on Bouldin Island and Holland Tract may filter pesticide residues and provide an immense surface area for soil microbes to break down any residues.

- Frequent pumping of drainage waters and levee seepage water on these islands provides continual flushing of water through the islands and reduces any buildup of pesticide concentrations.

Conclusions of Assessment of Agricultural Pesticide Residues

A detailed agricultural chemical use inventory, screening process, and soil sampling program were conducted to determine whether agricultural chemicals previously used on the DW project islands could degrade the quality of water stored on the islands. The most recent EPA and CDFA lists of known or suspected chemicals that leach to groundwater or surface water were used to identify compounds for laboratory analysis. A review of current CDFA and EPA lists of chemicals known or suspected to leach to groundwater has revealed that the initial soil investigation is valid and no additional pesticide residue analyses are warranted.

Results of the pesticide residue investigation indicate the following:

- Pesticide residues in DW project island soils are low to nondetectable for those chemicals known to have high leaching potential. In general, island soils do not contain significant concentrations of agricultural chemicals.

- Residual concentrations of atrazine, linuron, and diuron observed in one soil sample from Bacon Island were the result of recent use and did not represent levels of concern.

- Past agricultural practices and the chemicals used should not have a demonstrable effect on the water quality of water stored or used on the DW project islands.

- Federal or state water quality standards would not be exceeded in waters discharged from the DW project islands.

- No significant risks to wildlife or human health would result from inundation of island soils and discharge of water to Delta channels.

CONTAMINANTS RELATED TO BOATING RECREATION

Introduction

Under the DW project alternatives, a total of 38 private boating recreation facilities would be constructed on the exterior levees of the four project islands. Boating activity would occur in newly flooded areas within the perimeters of the project island levees and along existing Delta channels. Assuming a 70% occupancy rate of the boat slips located on the channel side of the levees, it is estimated that a total of 798 boats would be added to the number of registered boats in San Joaquin and Contra Costa Counties. Additional boating activity on Delta channel waterways is anticipated to increase the number of recreational use-days by 5%. Also, approximately 1,000 boats would be added to waters within the perimeters of the project island levees. The proposed facilities would provide limited fueling services for small boats used on the island interiors. Sewage pumpout services and fueling services would not be provided for boats docked in the Delta channels. (See Chapter 3J, "Recreation and Visual Resources".)

Sources of potential pollution resulting from the presence of recreation facilities and from boating activities include the discharge of petroleum-based materials (e.g., fuel, oil, and grease), sewage, and litter. Petroleum-based materials can enter the water from fuel spills, bilge pumps, and boat maintenance activities. Sewage can enter waterways as a result of direct discharges to waterways and incidental spills while boat holding tanks are being pumped out. Litter is generally the result of careless activity. Other miscellaneous contaminants can be released into Delta waterways as a result of boating activity; these include gray water and detergents from boat maintenance and domestic activities, and residues of antifouling chemicals released from boat paints.

Water Quality Issues and Regulatory Status

Discharges of petroleum-based products are the most significant potential water quality problem associated with boating activities. Petroleum products contain chemicals (polynuclear aromatic hydrocarbons) that are toxic to fish and wildlife. Oily films can develop on the water surface and limit gas exchange with the atmosphere and clog the gills of aquatic organisms. Discharges of sewage from boats can also pose a water quality problem. Untreated sewage can contain pathogens harmful to human health, create offensive odors, add nutrients that stimulate growth of nuisance algae and aquatic macrophytes, and introduce organic matter that requires large amounts of dissolved oxygen to decompose. Gray water, domestic wash water, and boat washing activities can add nutrients and detergents that degrade the water quality for aquatic organisms. The chemical TBT (tributyltin), used as an antifouling agent in some boat paints, has been a concern because it bioaccumulates in the tissues of some types of shellfish.

Regulatory programs exist to limit the pollution introduced from boating facilities. Fuel storage, distribution, and filling facilities are required to comply with local jurisdictional requirements for reporting and construction. Fuel storage is allowed only in underground storage tanks, and spill-protection devices, such as anti-backflow valves, must be installed on filling equipment. Fuel or oil spills of more than 42 gallons must be reported (Cal. Water Code Sec. 13272). Pumping of bilge water is considered a minor contributor of petroleum-based materials and the discharge of contaminated bilge water is illegal under U.S. Coast Guard regulations. Additionally, narrative water quality criteria of the Central Valley Regional Water Quality Control Board specify that discharges of petroleum hydrocarbons cannot be visibly detected on the water surface.

All boats with installed toilets must have marine sanitation devices (MSDs) approved by the U.S. Coast Guard. Certain types of MSDs treat the sewage, which can then be discharged directly to the water. MSDs constructed prior to 1980 are allowed to discharge sewage that has a fecal coliform level below 1,000 per 100 milliliters (ml) and that produces no visible floating solids; MSDs constructed after 1980 must reduce fecal coliforms to less than 200 per 100 ml, with suspended solids at less than 150 mg/l. A third type of MSD only provides storage for untreated sewage and must be pumped out at a marine pumping facility. Some boats have valves that allow direct discharge of untreated sewage; however, their use is illegal within 3 miles of the U.S. coastline. The Clean Water Act provides that fines of as much as $2,000 can be assessed for illegal discharges of sewage.

The use of TBT in antifouling paints is now restricted by the U.S. Department of Agriculture to boats longer than 82 feet. However, spray paint containing TBT can be purchased and legally used to protect the outboard-motor parts of pleasure boats. Replacements for TBT in antifouling paints are readily available.

Discussion of Potential Water Quality Effects of the Use of DW Facilities

Discharges of pollutants may increase as a result of the use of DW boating facilities. The types of potential effects of the use DW boating facilities would be identical under all three DW project alternatives because similar facilities would be constructed under each alternative. Additional discharges of petroleum-based products, sewage, and litter may be contributed to existing contaminant loading conditions in Delta channels and to waters contained within the perimeters of the project island levees.

For the purposes of this analysis, it is assumed that the water quality effects on Delta channels resulting from use of DW boating facilities would be proportional to the increase in recreation use-days relative to existing conditions in the Delta. Therefore, it would follow that use of DW boating facilities could increase pollutant loading in the Delta over existing conditions by approximately 5%.

It is assumed that the locations of the effects would be distributed around the four project islands relative to the locations of the DW boating facilities. Because sewage pumpout services will not be installed at DW boating facilities, the effects of incidental spills associated with sewage pumpout operations could increase near existing facilities in the Delta that provide pumping services for the general public.

The potential pollutants discharged within the perimeters of the project island levees are considered to be from newly introduced pollution sources to areas that have not been exposed to similar effects previously. The quantity of pollutants contributed is assumed to be proportional to the additional boats that would be present in San Joaquin and Contra Costa Counties. However, use of the boats on the island interiors would be lower than other typical Delta boat use because most boats on the island interiors would be used for hunting or other short-term uses, and surface water for boating may be limited seasonally or may vary annually on the DW project islands. Therefore, the quantity of pollutants from the estimated 1,000 boats on the island interiors would be somewhat less than the quantity added by an equivalent number of boats operating in the Delta channels. The effects could occur within the perimeter levees in the short term but eventually would be distributed to Delta channel locations as reservoir storage water was released. However, the distribution of pollutants added to the habitat islands would generally be confined within the perimeter levees.

The effects of pollutants being added to Delta channels and the DW project islands as a result of DW boating recreation facilities are considered minor. Although periodic pollution problems related to boating facilities may occur in Delta waters, the effect and episodes of occurrence are minor relative to pollution problems of other contaminants in the Delta, such as heavy metals, pesticides, and many synthetic organic chemicals. Additionally, the nature of the private use proposed for DW recreation facilities will preclude concentrated or increased boating activity at facility locations.

Pollution Prevention Controls for DW Operations

The potential pollution problems that could result from use of DW recreational boating facilities would be minimized further through implementation of protective measures and provision of incentives for the boat users to practice proper waste disposal. Fueling facilities separate from the DW boating facilities should have an oil spill response and cleanup plan, proper containment and cleanup equipment, and personnel that are trained and prepared in the emergency implementation of such equipment and procedures. Solid waste disposal facilities separate from the DW boating facilities should be readily available to control litter problems around the facilities.

The potential effects from existing public sewage pumpout facilities could be minimized through provision of such services at all or some of the private DW project facilities. Providing the pumpout services would reduce effects at existing public facilities and discourage illegal discharges. Covenants placed on use of the boat docks should also be considered to reduce potential pollution problems; these might include disallowing the fueling of boats from personal containers.

CITATIONS

Printed References

California. Department of Food and Agriculture. 1987. Report to the legislature, the Department of Health Services, and the Water Resources Control Board on the Pesticide Contamination and Prevention Act of 1985. Sacramento, CA.

__________. Department of Food and Agriculture. 1989. Sampling for pesticide residues in California well water; 1989 update, well inventory data base. December 1, 1989. Environmental Hazards Assessment Program. Sacramento, CA.

__________. Department of Food and Agriculture. 1992. Report to the legislature, the Department of Health Services, and the Water Resources Control Board on the Pesticide Contamination and Prevention Act of 1985. Sacramento, CA.

__________. Department of Water Resources. 1986. Sacramento-San Joaquin Delta water quality surveillance program for Water Right Decision D-1485. Volumes 1 and 2. Central District. Sacramento, CA.

__________. Department of Water Resources. 1988. Sacramento-San Joaquin Delta water quality surveillance program - 1988: monitoring results pursuant to conditions set forth in Delta Water Right Decision 1485. Sacramento, CA.

__________. Department of Water Resources. 1989. The Delta as a source of drinking water: monitoring results, 1983 to 1987. Sacramento, CA. Prepared for Interagency Delta Health Aspects Monitoring Program, Sacramento, CA.

__________. Health and Welfare Agency. 1988. Chemicals known to the state to cause cancer or reproductive toxicity (Proposition 65 list). Sacramento, CA.

__________. Health and Welfare Agency. 1993. Chemicals known to cause cancer or reproductive toxicity. Sacramento, CA.

__________. State Water Resources Control Board. 1983. Groundwater contamination by pesticides: a California assessment. Sacramento, CA. Prepared by Ramlit Associates, Inc., Berkeley, CA.

Central Valley Regional Water Quality Control Board. 1993. Water quality objectives and hazardous and designated levels for chemical constituents. Sacramento, CA.

Farm Chemicals Handbook. 1989. Meister Publishing Company. Willoughby, OH.

Thomson, W. T. 1976. Agricultural chemicals. (Book 1 - Insecticides.) Thomson Publications. Indianapolis, IN.

U.S. Environmental Protection Agency. 1988a. Disulfoton health advisory. Office of Drinking Water. Washington, DC.

__________. 1988b. Atrazine health advisory. Office of Drinking Water. Washington, DC.

Verschueren, K. 1983. Handbook of environmental data on organic chemicals. Van Nostrand Reinhold Company, Inc. New York, NY.

Weed Science Society of America. 1983. Herbicide handbook of the Weed Science Society of America. Champaign, IL.

Personal Communications

Ali, Syed. Environmental toxicologist. California State Water Resources Control Board, Sacramento, CA. February 7, 1989 - memorandum.

Cockrell, Seth. Reclamation district supervisor. Reclamation District 108, Holland Tract, CA. January 4, 1994 - telephone conversation regarding pesticide use on Holland Tract.

Cornacchia, John. Chemist. Cal-Enseco Laboratory, Sacramento, CA. January 18, 1989 - telephone conversation; February 15, 1989 - letter.

Duncan, David. Pesticide specialist. California Department of Food and Agriculture, Sacramento, CA. January 4, 1994 - telephone conversation regarding specific numerical values and standards for atrazine in soil.

Falkenstein, Michael. Environmental specialist. California State Water Resources Control Board, Sacramento, CA. December 1, 1988 - letter.

Hudson, Scott. Assistant agricultural commissioner. San Joaquin County, Stockton, CA. December 1, 1993 - telephone conversation regarding chemical use on Bacon Island and Holland Tract.

Johnson, Bruce. Agricultural chemical analyst. California Department of Food and Agriculture, Sacramento, CA. December 9, 1993 - telephone conversation regarding specific numerical values.

Shimasaki, Kyser. Farmer. Kyser Farms, Bacon Island, CA. December 7, 1993 - telephone conversation and facsimile description of pesticide use on Bacon Island.

Wernette, Frank. Biologist. Bay-Delta Unit, California Department of Fish and Game, Stockton, CA. June 17, 1994 - telephone conversation regarding pesticide use on agricultural lands used as state and federal wildlife management areas.

Wilkerson, Clyde. Farming operations supervisor. Bouldin Island Farming Company, Stockton, CA. November 30, 1993 - telephone conversation regarding pesticide use on Bouldin Island and Webb Tract.

Table C6-1. Agricultural Chemicals Used on the DW Project Islands before the 1988 Soil Analysis

		Island Use				Ratings			DWR and SWRCB Monitoring Programs		
Common Name	Use	Bacon	Bouldin	Holland	Webb	CDFA/EPA Classification	DWR Pesticide Rating Code[a]	Prop. 65 Compound?[b]	Detected in SWRCB TSMP?	Detected in DWR Delta Monitoring?	Target Pesticide?
Agrimycin	Fungicide	X				Nonrestricted	NA	No	No	No	No
Aldicarb	Insecticide	X				Restricted	Group 7	No	No	No	No
Aldrin	Insecticide	X		X	X	Banned[c]	Group 9	Yes	No	No	Yes
Aminotriazole	Herbicide		X			Restricted	Group 1	No	No	No	Yes
Atrazine	Herbicide	X	X	X	X	Nonrestricted[d]	Group 9	No	No	No	Yes
Bayleton	Fungicide	X				Nonrestricted	(Group 6)	No	No	No	No
Benlate	Fungicide	X				Nonrestricted	Group 7	No	No	No	No
Bivert	Adjuvant	X				Nonrestricted	NA	No	No	No	No
Bravo 500	Fungicide	X				Nonrestricted	Group 9	No	No	No	No
Bromoxynil	Herbicide	X				Nonrestricted	Group 9	No	No	No	No
Captan 50 W	Fungicide	X				Nonrestricted	Group 8	No	No	No	No
Carbaryl	Insecticide	X		X		Restricted	Group 6	No	No	No	Yes
Carbon bisulfide	Fungicide	X		X	X	Nonrestricted	NA	No	No	No	No
Chlorophacinone	Rodenticide			X	X	Nonrestricted	Group 8	No	No	No	No
Chlorpyrifos	Insecticide	X				Nonrestricted	Group 9	No	No	No	No
Devrinol	Herbicide		X			Nonrestricted	(Group 6)	No	No	No	No
Dicamba	Herbicide	X		X	X	Restricted	(Group 1)	No	No	No	Yes
Dicofol	Acaracide	X	X			Nonrestricted	NA	No	No	No	Yes
Dinoseb	Herbicide	X		X	X	Restricted	(Group 3)	No	No	No	Yes
Disulfoton	Insecticide	X	X	X	X	Restricted	Group 9	No	No	No	No
DDT and metabolites	Insecticide	X	X	X	X	Banned[c]	Group 9	Yes	Yes	No	Yes
Diphacinone	Rodenticide			X	X	Nonrestricted	(Group 8)	No	No	No	No
Diesel Oil	Varies			X	X	Nonrestricted	NA	NA	NA	NA	No
Diquat	Herbicide	X				Nonrestricted	(Group 2)	No	No	No	No
Diuron	Herbicide	X				Nonrestricted[e]	Group 6	No	No	No	Yes
Endosulfan	Insecticide	X	X	X	X	Restricted	Group 7	No	Yes	No	Yes
Eradicane	Herbicide		X			Nonrestricted	Group 4	No	No	No	No
Glyphosate	Herbicide	X		X	X	Nonrestricted	Group 7	No	No	No	Yes
Kryocide	Insecticide	X				Nonrestricted	Group 7	No	No	No	No
Linuron	Herbicide	X				Nonrestricted	Group 7	No	No	No	Yes
MCPA	Herbicide		X			Restricted	Group 3	No	No	Yes	Yes
Mercury	Fumigant	X				Nonrestricted	Group 9	No	Yes	No	Yes
Methomyl	Insecticide	X	X			Restricted	Group 1	No	No	No	Yes
Methyl bromide	Fumigant			X	X	Nonrestricted	Group 1	No	No	No	No
Methamidphos	Insecticide	X	X			Restricted	Group 1	No	No	Yes	Yes
Mor-act	Foaming	X				Nonrestricted	NA	No	No	No	No
Methyl parathion	Adjuvant insecticide	X				Restricted	Group 6	No	No	Yes	No
Mevinphos	Insecticide	X				Restricted	NA	No	No	No	No
Parathion	Insecticide	X		X	X	Restricted	Group 9	No	No	No	No
Paraquat	Herbicide	X				Restricted	Group 1	No	No	No	Yes
Propargite	Insecticide	X	X	X		Nonrestricted	Group 9	No	No	No	No
Pyrenone	Insecticide	X				Nonrestricted	Group 7	No	No	No	No
R-11 spreader	Adjuvant	X				Nonrestricted	NA	No	No	No	No

Table C6-1. Continued

Common Name	Use	Island Use: Bacon	Bouldin	Holland	Webb	Ratings: CDFA/EPA Classification	DWR Pesticide Rating Code[a]	Prop. 65 Compound?[b]	DWR and SWRCB Monitoring Programs: Detected in SWRCB TSMP?	Detected in DWR Delta Monitoring?	Target Pesticide?
R-56 spreader	Adjuvant	X				Nonrestricted	NA	No	No	No	No
Ridomil 2E	Fungicide	X				Nonrestricted	Group 9	No	No	No	No
Ridomil 81 WP	Fungicide	X				NA	Group 9	No	No	No	No
Rovral	Fungicide	X				Nonrestricted	Group 5	No	No	No	No
Sodium fluroacetate	Rodenticide	X		X	X	Restricted	Group 7	No	No	No	No
Sulfur	Various	X				Nonrestricted	NA	No	No	No	No
Systox	Insecticide	X				Restricted	NA	No	No	No	No
Toxaphene	Insecticide			X		Restricted	Group 9	Yes	Yes	No	Yes
Triclopyr	Herbicide		X	X		Nonrestricted	NA	No	No	No	No
Trifluarlin	Herbicide	X	X	X	X	Nonrestricted	Group 9	No	No	No	No
Trifol	Adjuvant	X				Nonrestricted	NA	No	No	No	No
2,4-D	Herbicide	X	X	X	X	Restricted	Group 1	No	No	Yes	Yes
2,4,5-T	Herbicide	X		X		Restricted	Group 9	No	No	No	Yes
Zinc phosphide	Rodenticide	X				Discontinued		No	No	No	No

[a] Rating codes defined in DWR (1986): compounds in parentheses rated by Jones & Stokes Associates based on water solubility and octanol-water partition coefficient. Sources of chemistry information: Weed Science Society of America 1983, SWRCB 1983, Verschueren 1983, Thomson 1976.

[b] California Health and Welfare Agency 1988.

[c] Banned chemicals not known to be used on islands after being banned.

[d] Under review by CDFA in 1988 for restricted classification in California. Now classified as restricted.

[e] Diuron under review by CDFA in 1988 for a modification of use, including application by a licensed pest control advisor and a ban in all groundwater recharge areas. Now a restricted chemical; CDFA has established use restriction zones.

NA = not available.

C-061897

Table C6-2. Agricultural Chemicals Found in Groundwater and Chemicals Exhibiting Potential to Leach to Groundwater

Agricultural Chemicals Found in Groundwater

Atrazine
Bentazon
Bromacil
Diuron
Prometon
Simazine

Agricultural Chemicals Suspected of Leaching to Groundwater

Acephate
Alachlor
Aldicarb
Azinphos-methyl

Bensulide
Butylate

Chloropicrin
Chlorosulfuron
Cyanazine
Cycloate

2,4-D, dimethylamine salt
Diazinon
Dichlobenil
Dichloran
Diethatyl-ethyl
Dimethoate
Diquat dibromide
Disulfoton

EPTC
Ethofumesate
Ethoprop

Fenamiphos
Fluometuron
Fonofos
Fosetyl-Al technical

Hexazinone

Linuron

Metalaxyl
Methiocarb
Methomyl
Methyl isothiocyanate
Metolachlor
Metribuzin
Molinate

Napropamide
Naptalam, sodium salt
Norflurazon

Oryzalin
Oxydemeton-methyl

Parathion
Pebulate
Prometron
Propyzamide

Sulfometuron-methyl

Tebuthiruon
Triallate

Vernolate

Source: CDFA 1992.

Table C6-3. Results of Subsurface Soil Pesticide Residue and Heavy Metals Analysis of Soil Borings from the DW Project Islands

Analysis Method	Target Chemicals	Detection Limits	Bacon Island[a] E-5 (16.0'-16.5')	Bacon Island[a] E-6 (1.5'-2.0') (16.0'-16.5')	Bouldin Island[a] E-7 (6.0'-6.5') (16.0'-16.5')	Bouldin Island[a] E-8 (4.0'-4.5') (16.0'-16.5')	Holland Tract[a] E-1 (11.0'-11.5')	Holland Tract[a] E-2 (2.5'-3.0') (11.0'-11.5')	Webb Tract[a] E-3 (11.0'-11.5') (16.0'-16.5')	Webb Tract[a] E-4 (3.5'-4.0') (11.0'-11.5')
EPA Method 8080										
Organochlorine pesticides	Aldrin	8 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	dieldrin	16 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	4,4'-DDE	16 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	4,4'-DDD	16 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	4,4'-DDT	16 ppb	ND	ND	ND	ND	ND	ND	ND	ND
EPA Method 8150										
Chlorinated phenoxy herbicides	dicamba	200 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	dinoseb	200 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	2,4-D	25 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	2,4,5-T	5 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	MCPA/MCPP	5,000 ppb	ND	ND	ND	ND	ND	ND	ND	ND
EPA Method 632										
Carbamate and urea pesticides	aldicarb	500 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	methomyl	500 ppb	ND	ND	ND	ND	ND	ND	ND	ND
	sevin	500-5,000 ppb[b]	ND	ND	ND	ND	ND	ND	ND	ND
	diuron	50-500 ppb[b]	ND	ND	ND	ND	ND	ND	ND	ND
	linuron	50-500 ppb[b]	ND	ND	ND	ND	ND	ND	ND	ND
EPA Method 8190										
Triazines	atrazine	100 ppb	ND	ND	ND	ND	ND	ND	ND	ND
Special method	methamidophos	50 ppb	ND	ND	ND	ND	ND	ND	ND	ND
Metal analysis (ICAP)[c]	arsenic	1.0 mg/l	ND	ND	ND	ND	ND	ND	ND	ND
	cadmium	0.10 mg/l	ND	ND	ND	ND	ND	ND	ND	ND
	copper	0.10 mg/l	ND	0.10 mg/l[d]	ND	ND	ND	ND	ND	0.10 mg/l[d]
	lead	1.0 mg/l	ND	ND	ND	ND	ND	ND	ND	ND
	mercury	0.010 mg/l	ND	ND	ND	ND	ND	ND	ND	ND

Notes: Analysis by Cal-Enseco Laboratory, Sacramento, CA (December 1988).
ND = not detected.

[a] Sample depth in feet is noted in parentheses for each borehole.
[b] Some detection limits raised because of matrix interferences.
[c] Metal determination conducted using DHS California Assessment Manual Waste Extraction Test.
[d] Copper at detection limit was found in upper soil sample.

Table C6-4. Results of Soil Pesticide Residue and Heavy Metals Analysis of DW Project Island Surface Soils

Analysis Method	Target Pesticides	Detection Limits	Island: Bacon	Island: Bouldin	Island: Holland	Island: Webb
EPA Method 8080						
Organochlorine pesticides	Aldrin	8.0 ppb	ND	ND	ND	ND
	dieldrin	8.0-16 ppb	ND	200 ppb	25 ppb	ND
	endosulfan I	8.0 ppb	ND	ND	ND	ND
	4,4'-DDT	16 ppb	ND	150 ppb	ND	ND
	4,4'-DDE	16 ppb	ND	ND	ND	ND
	4,4'-DDD	16 ppb	ND	ND	ND	ND
	toxaphene	160 ppb	ND	ND	ND	ND
EPA Method 8150						
Chlorinated phenoxy acid herbicides	dinoseb	50 ppb	ND	ND	ND	ND
	dicamba	1,000 ppb	ND	ND	ND	ND
	2,4-D	25-250 ppb	ND	ND	ND	ND
	2,4,5-TP	5.0 ppb	ND	ND	ND	ND
	2,4,5-T	5.0 ppb	ND	ND	ND	ND
	MCPA	5,000-50,000 ppb	ND	ND	ND	ND
EPA Method 8190						
Triazine herbicides	atrazine	20 ppb	ND	320 ppb	49 ppb	ND
EPA Method 632						
Carbamate and urea pesticides	diuron	500 ppb	1,400 ppb	ND	NA	NA
	linuron	500 ppb	1,100 ppb	ND	NA	NA
	aldicarb	500 ppb	ND	ND	NA	NA
Special method	methamidophos	50 ppb	ND	ND	NA	NA
	paraquat	2 $\mu g/g$	ND	NA	NA	NA
DHS CAM waste extraction test	arsenic	1.0 mg/l	ND	ND	ND	ND
	cadmium	0.1 mg/l	ND	ND	ND	ND
	copper	0.11 mg/l	ND	0.2 mg/l	ND	ND
	lead	1.0 mg/l	ND	ND	ND	ND
	mercury	0.010 mg/l	ND	ND	ND	ND

Notes: Analyses performed by Cal-Enseco Laboratory, Sacramento, CA, October 1988.

ND = not detected.

NA = compound was not analyzed because historical records show that it has not been used on the island.

C-061900

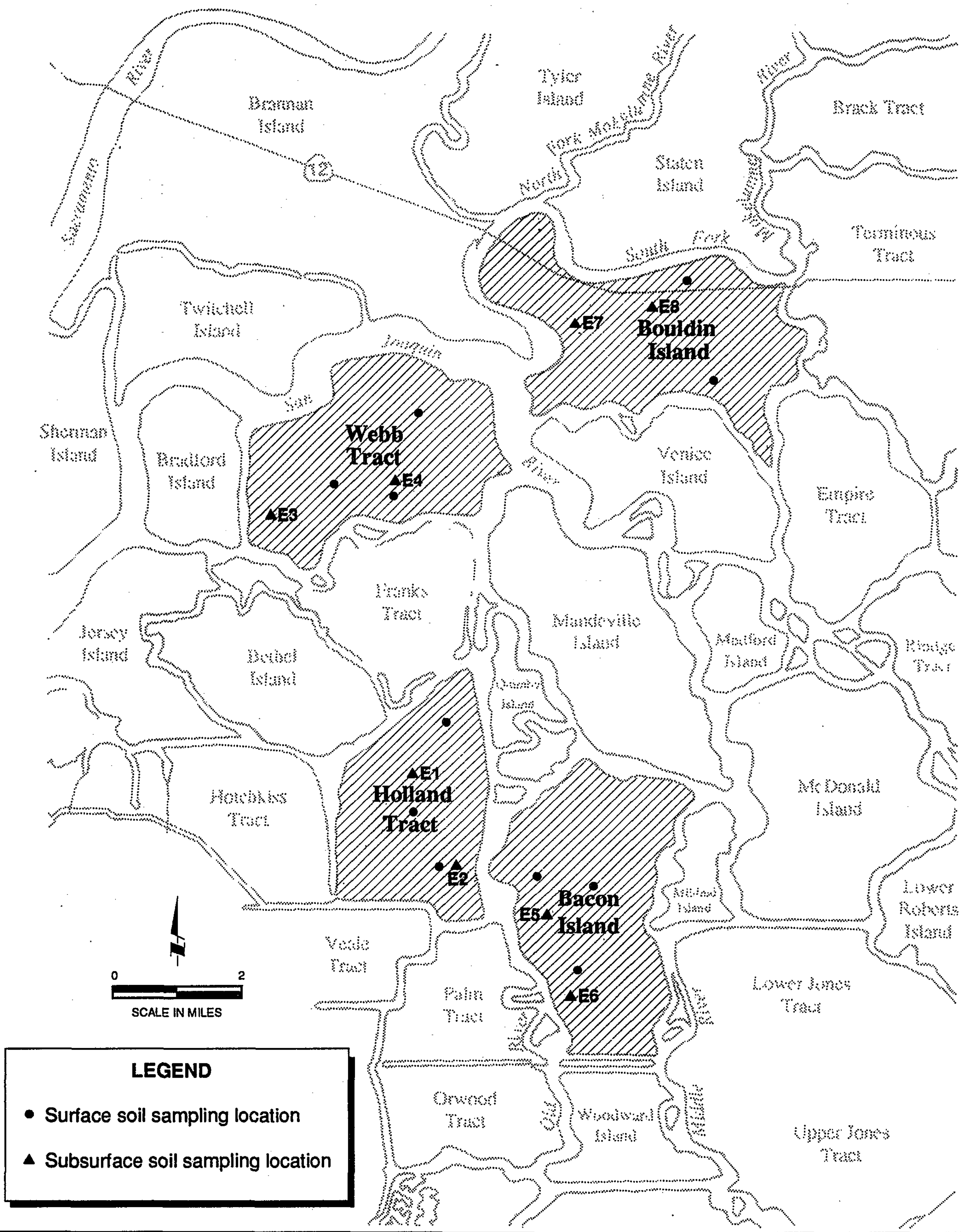

Figure C6-1.
Approximate Soil Sampling Locations of the Pesticide Residue Study

DELTA WETLANDS PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates